Considerations in the Application of Nanoinformatics to Occupational Safety and Health

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The findings and conclusions in this report are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

NIOSH

Growth of Nanotechnology

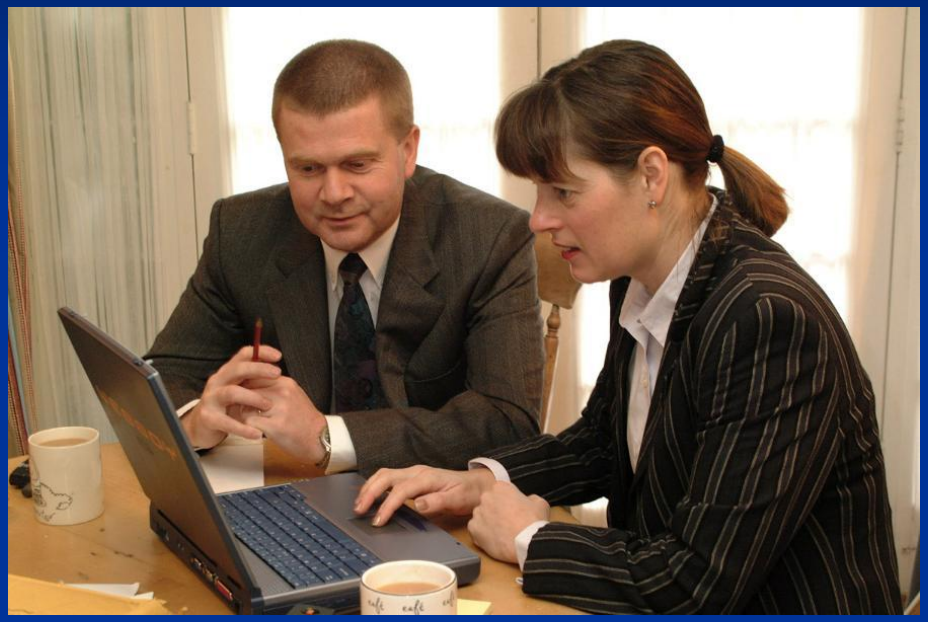
- Effective growth of nanotechnology
  - Depends on society's perception of the safety of nanomaterials
  - Will be delayed if perceptions of hazard and risk are not addressed
- Workers are the first in society
  - To have exposure to nanomaterials
    - Often at levels higher than consumers
  - Are likely to be the first people to show health effects

Occupational Safety and Health (OSH) is an Applied Field

- The focus is to protect working people from hazards at work
  - By conducting research
  - By developing guidance
- Data, information, and knowledge—generated for specific purposes
  - Hazard identification
  - Exposure assessment
  - Risk characterization
  - Risk management

OSH Information Has a Variety of Users

Photo courtesy of freefoto.com



Employers: Responsible for safe and healthy workplaces

Workers: Self-protection

General public: Public awareness

OSH Information Has a Variety of Users (Cont'd)

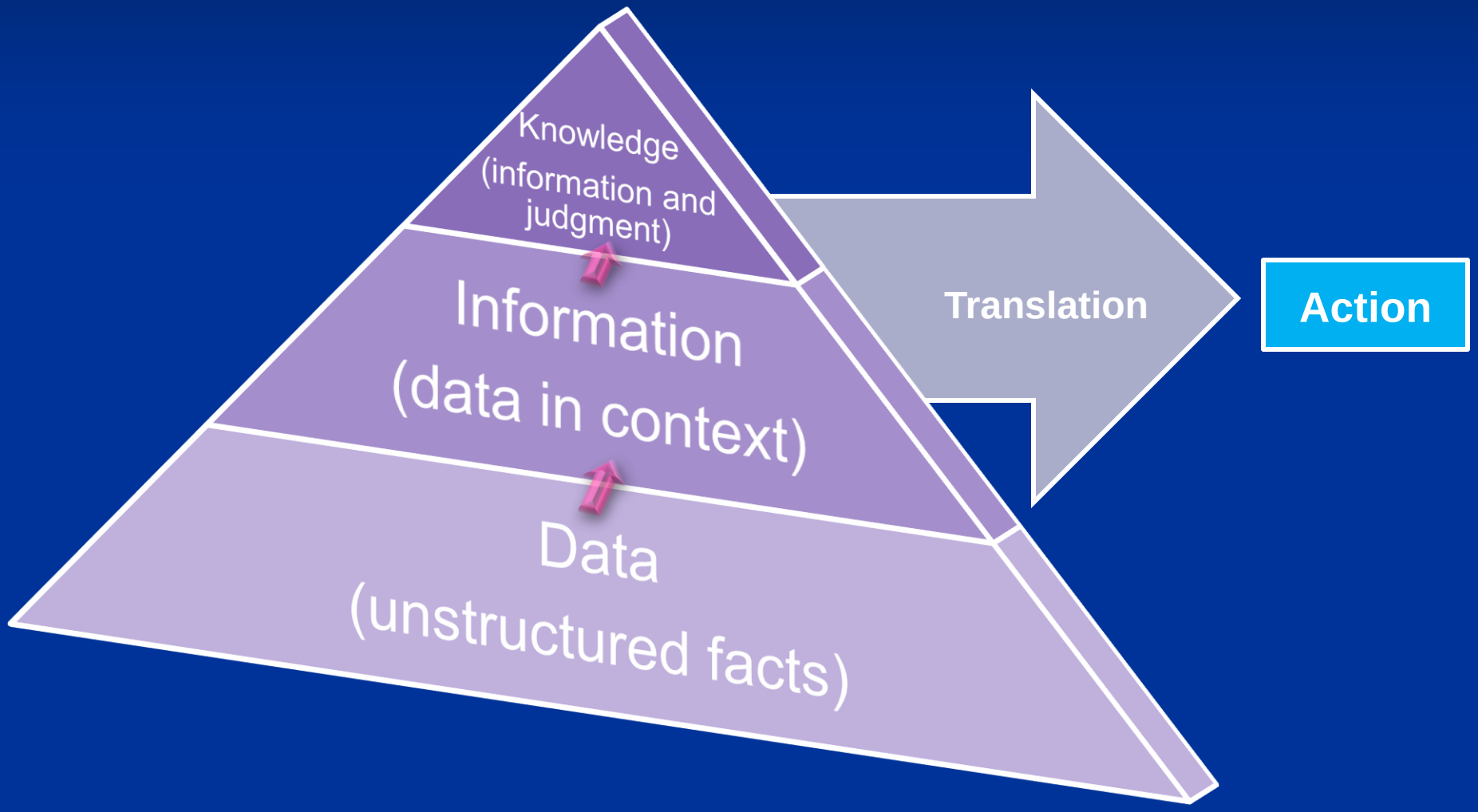
Government Agencies: Provide guidance and regulation

Trade Association/Unions: Support employees and workers

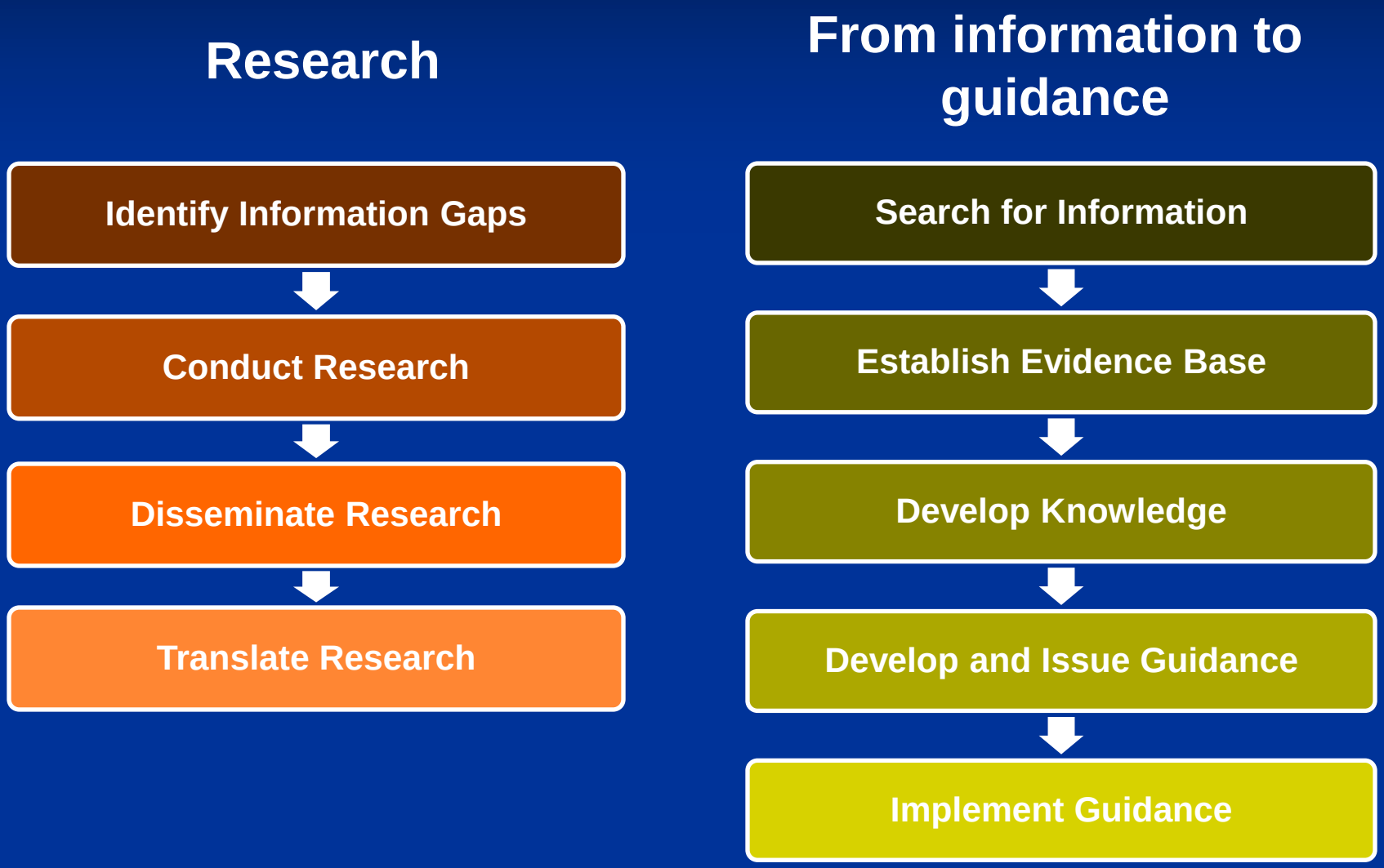
The Question

What role can nanoinformatics play in OSH?

Informatics Helps the Progression Toward Preventive Action



Research and Guidance



Examples of OSH Information Relevant in Protecting Workers from Nanomaterial Hazards

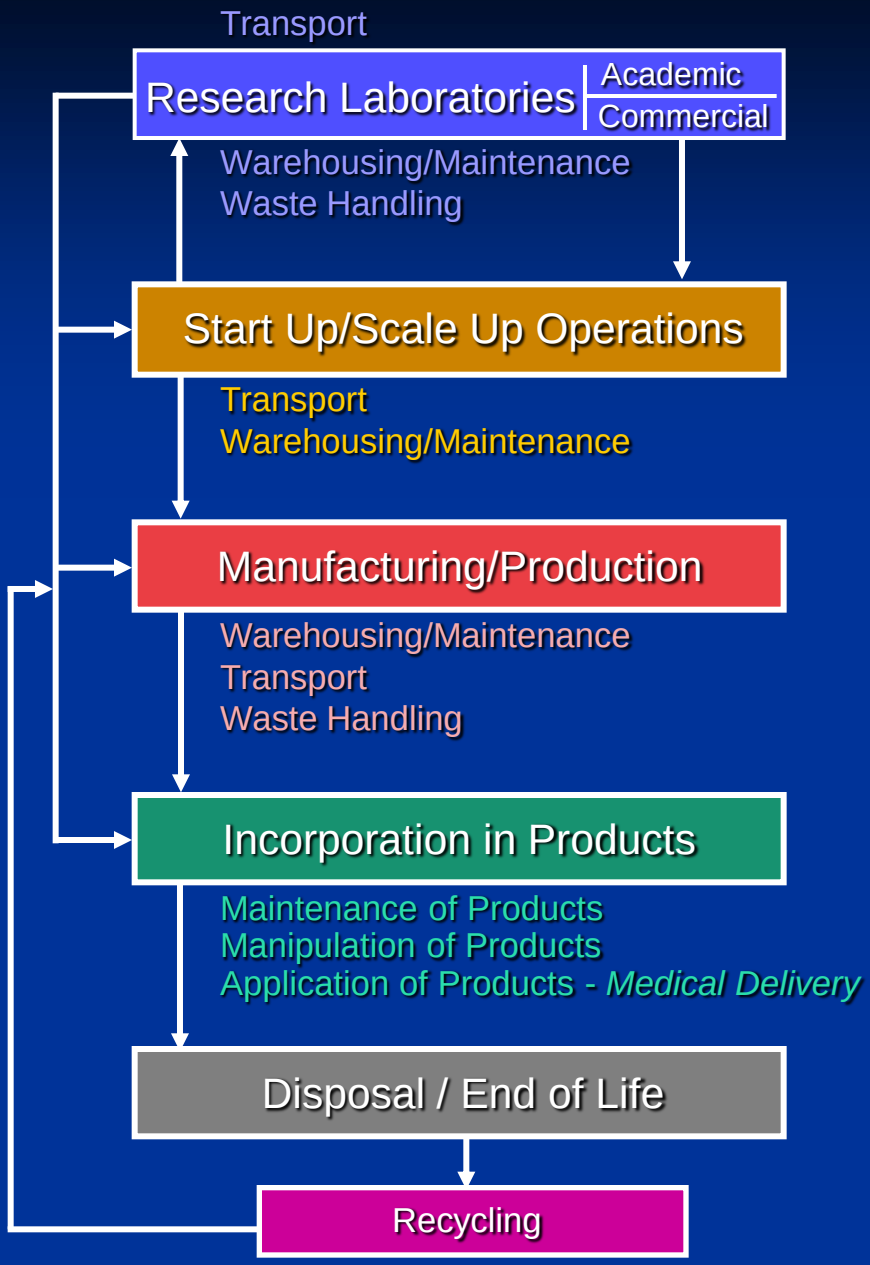
Hazard	Exposure	Risk	Management	
Toxicity data	Exposure data •by job/task •by sector •by particle type •by metrics •by equipment characteristics	Quantitative risk assessments	Hazard banding	Control banding
Particle characteristics		Qualitative risk assessments	Specific OELs*	Categorical OELs*
Hazard surveillance data		Characteristics of animal models	Risk communication	Control guidance
			Green chemistry	
Safety research data •Explosivity •Flammability	Job/exposure matrices	Epidemiologic research data	Medical surveillance guidance	Medical surveillance data
	Exposure registry data	Uncertainty data	Control research data	Compliance research information

*OEL (Occupational Exposure Limit)

From Information to Guidance

	Search for Information →	Establish Evidence Basis →	Develop Knowledge →	Develop and Issue Guidance →	Implement Guidance
Hazard identification					
Exposure assessment					
Risk characterization					
Risk management					

Nanomaterial Workplaces



etc.

Sector: **Food**

Sector: **Electronics**

Sector: **Medicine**

Sector: **Energy**

Sector: **Materials**

Workplaces	*Nanomaterial Type*			
	Carbon Nanotubes	Metal Oxides	Dendrimers	Fullerenes Metal Nanomaterials Nanowires Nanostructured Metals Nanoporous Materials Nanoscale Encapsulation
Laboratory Research				
Start up/Pilot				
Manufacturing				
Production				
Disposal				

Utility of Nanoinformatics in OSH

- Predict hazards and risks of nanomaterials for specific nanomaterials or categories of nanomaterials
  - Prioritize toxicologic research
  - Develop occupational exposure limits (OELs) for categories of nanomaterials
- Be able to characterize a range of reported exposures, controls, or risk management efforts
  - New high power search engines
  - New databases
- Assist in design of safer nanomaterials

Concerns about nanoinformatics

- Informatics is a broad term
- Lack of specific objectives can lead to ineffective use of resources
- Costly to maintain
- Occupational safety and health needs are specific and applied
- Opportunity costs of building information structures versus generating new information
- Need to distinguish between data, information and knowledge, and resources needed to develop each

Conclusions

- Scarce resources for OSH should be invested primarily in activities that address targeted outcomes

- Nanoinformatics may be a basis for:
  - Predicting the hazards of new nanomaterials and appropriate controls
  - Characterizing the range of hazards, exposures, risks, and guidance
  - Designing safer nanomaterials